Remarks/Arguments

Claims 1-3, 5-7, 10, 12-22, 24 and 26-34 remain in the application. Claims 1, 3, 6, 10, 13, 16-18, 20-22, 24, and 26-33 have been amended. Claims 35-37 have been newly added.

Claim Rejections 35 USC § 102

Claims 26-31 are rejected under 35 U.S.C. 102(a) as being anticipated by Hosokawa (US Patent Application 2001/0015074A1).

Hosokawa teaches an apparatus and method for transporting substrates through a semiconductor processing system. The apparatus comprises a central wafer handling vacuum chamber and a number of peripheral processing chambers. The wafers are processed in vacuum in the various processing chambers and transported without being exposed to ambient conditions. A microprocessor controller is provided to control processing and movement of wafers.

Referring to amended claim 26, Applicant discloses and claims a method for thermal processing a workpiece defined by the following limitations (emphasis mine):

> **dividing a thermochemical process** for improving material characteristics of an iron-base alloy material of the workpiece **into at least two portions and determining corresponding thermochemical processing conditions** based on operational ranges of at least two thermochemical processing cells, wherein **the determined corresponding thermochemical processing conditions are variable within ranges smaller than total ranges of the processing conditions of the thermochemical process**;
>
> providing the workpiece to a first thermochemical processing cell linked to a common chamber containing an atmosphere other than ambient air;
>
> thermochemical processing the workpiece by providing first thermochemical processing conditions of the thermochemical process;

transferring via the common chamber the workpiece from the first thermochemical processing cell to a second thermochemical processing cell linked to the common chamber after elapse of a first predetermined time interval;

thermochemical processing the workpiece by providing second thermochemical processing conditions of the thermochemical process; and,

removing the workpiece from the second thermochemical processing cell after elapse of a second predetermined time interval.

In a first step of the method of claim 26 a thermochemical process is divided into at least two portions and corresponding thermochemical processing conditions are determined. Dividing the thermochemical process enables processing of the workpiece in two or more thermochemical processing cells, wherein the thermochemical processing conditions in each of the processing cells are variable within ranges which are smaller than the total ranges of the processing conditions of the complete process, as defined by the limitations of claim 26.

Dividing the thermochemical process into at least two portions performed under conditions which are only changed within a portion of the total range of processing conditions of the complete thermochemical process has numerous advantages for modern thermochemical processing applications. For example, combining various different thermochemical processing steps into one set of thermochemical processing conditions for processing a workpiece allows implementation of a large number of different sets of thermochemical processing conditions using a fixed number of thermochemical processing cells being smaller than the number of sets of thermochemical processing conditions realized. Further, numerous sets of different thermochemical processing conditions are provided in parallel without substantially changing operating conditions in each of the thermochemical processing cells. Changing the operating conditions within a thermochemical processing cell requires a substantial amount of time and energy. Therefore, varying the processing conditions in each of the thermochemical processing cells within a portion of the total range of processing conditions for a complete thermochemical process provides considerable time as well as energy savings.

Additionally, application of the method defined by the limitations of amended claim 26 allows use of thermochemical processing cells, which are operable within a narrow operating range considerably reducing manufacturing costs of each of the thermochemical processing cells, as well as prolonging its lifetime by reducing material fatigue.

Cited reference Hosokawa does not teach dividing a thermochemical process into at least two portions for processing a workpiece in at least two thermochemical processing cells. Furthermore, Hosokawa does not teach the limitation of the thermochemical process being for improving material characteristics of an iron-base alloy material of the workpiece, but processes for semiconductor production such as chemical vapor deposition, physical vapor deposition, and etching. Therefore, Hosokawa's teachings relate to a completely different field in the art, namely semiconductor production, with its specific requirements such as a dust free and contaminants free environment during processing and handling between different processing cells. Dividing a thermochemical process for semiconductor production into two or more processing steps for processing in two or more processing cells as defined by the limitations of amended claim 26 is not of advantage due to the increased risk of contamination of the wafer during transport from one processing cell to another.

Applicant respectfully submits that amended method claim 26 is not anticipated by Hosokawa and, therefore, allowable.

Referring to amended claim 27, Applicant discloses and claims the method defined by the limitations of claim 26, further comprising the limitation of: "providing a second workpiece to the first thermochemical processing cell after transferring the workpiece to the second thermochemical processing cell". This method is highly advantageous by enabling simultaneous processing of two workpieces, the first one being processed in the second thermochemical processing cell for second thermochemical processing while the second workpiece is processed in the first thermochemical processing cell for first thermochemical processing. Hosokawa does not teach anything similar to this method.

Referring to amended claim 28, Applicant discloses and claims the method defined by the limitations of claim 26 further comprising the limitations of: "transferring via the common chamber the workpiece from the second thermochemical processing cell to a third thermochemical processing cell linked to the common chamber;" and "thermochemical processing the workpiece by providing third thermochemical processing conditions of the thermochemical process". Dividing a thermochemical process into three portions for processing the workpiece in three thermochemical processing cells further increases the potential for optimizing the operation of a multi-cell thermal processing unit as well as the lifetime of each processing cell by reducing the operational ranges of each processing cell. Hosokawa does not teach anything similar to this method.

Keeping at least one of the thermochemical processing conditions substantially fixed, as defined by the limitations of claim 29, further increases the lifetime of a processing cell as well as reduces manufacturing costs by simplifying construction and process control of a thermochemical processing cell. Hosokawa does not teach substantially fixed processing conditions.

Applicant respectfully submits that each of claims 27 – 31 depend on a claim that is believed to be allowable and as such are also allowable.

Claim Rejections 35 USC § 103

Claims 1-3, 5-7, 10, 12-14, 16-22, 24, and 26-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pelissier (US Patent 6,065,964) in view of Hosokawa (US Patent Application 2001/0015074A1).

Claims 1-3, 5-7, 10, 12-14, 16-22, 24, and 26-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP Patent 08178535 in view of Hosokawa (US Patent Application 2001/0015074A1).

Pelissier teaches a vaccum thermal processing installation for use under a rarefied atmosphere including several processing cells linked to a common air-tight vacuum

chamber. By feeding all workpieces through a common vaccum chamber, improved vaccum conditions are achievable within each processing cell.

Japanese Patent 08178535 teaches a heat processing furnace comprising a vacuum purging chamber for loading and unloading workpieces, a main transporting chamber and a plurality of processing chambers such as a burn-off chamber, vacuum sintering chambers, and a cooling chamber. Workpieces are loaded and unloaded through the vacuum purging chamber. A transport mechanism in the transporting chamber transports the workpieces to and from the various processing chambers.

Hosokawa teaches an apparatus and method for transporting substrates through a semiconductor processing system. The apparatus comprises a central wafer handling vacuum chamber and a number of peripheral processing chambers. The wafers are processed in vacuum in the various processing chambers and transported without being exposed to ambient conditions. A microprocessor controller is provided to control processing and movement of wafers.

Regarding amended claim 1, Applicant discloses and claims a multi cell thermal processing unit comprising (emphasis mine):

> an air tight expandable common chamber module for containing an atmosphere other than ambient air, the chamber module comprising N ports;
>
> a loading cell linked to the first port of the common chamber module via a gas tight door for providing to and receiving from the common chamber module an iron-base alloy workpiece;
>
> a **first thermochemical processing cell** linked to the second port of the common chamber module via a heat insulating door for thermochemical processing the workpiece, the first thermochemical processing cell for providing **substantially fixed first thermochemical processing conditions of a thermochemical process for improving material characteristics of the iron-base alloy material of the workpiece**;
>
> a **second thermochemical processing cell** linked to the third port of the common chamber module via a heat insulating door for thermochemical processing the workpiece, the second thermochemical processing cell for providing **substantially fixed second thermochemical processing conditions of the thermochemical process**;
>
> a transport mechanism disposed within the common chamber module for handling and transporting the workpiece within the thermal processing unit;

at least a processor in control communication with the first thermochemical processing cell, the second thermochemical processing cell, and the transport mechanism for:

processing data related to the thermochemical process in order to **divide the thermochemical process into at least two portions and to determine at least the first and second thermochemical processing conditions based on operational ranges of at least the first and second thermochemical processing cells** for optimizing operation of the multi cell thermal processing unit;

controlling provision of the first and the second thermochemical processing conditions; and,

controlling handling and transportation of the workpiece within the thermal processing unit;

and,

N-3 sealing covers for airtightly sealing the remaining N-3 ports, the covers being removable for mating the common chamber module to a processing cell or another common chamber module.

The limitations of amended claim 1 define a multi cell thermal processing unit comprising a first and a second thermochemical processing cell for providing substantially fixed first and second thermochemical processing conditions, respectively, for processing a workpiece. Using a processor a thermochemical process for processing the workpiece is divided into two or more portions and the corresponding thermochemical processing conditions are determined for successively processing the workpiece in the first and then in the second thermochemical processing cell.

Dividing the thermochemical process into at least two portions performed under substantially fixed conditions or conditions which are only changed within a portion of the total range of processing conditions of the complete thermochemical process has numerous advantages for modern thermochemical processing applications. For example, combining various different thermochemical processing steps into one set of thermochemical processing conditions for processing a workpiece allows implementation of a large number of different sets of thermochemical processing conditions using a fixed number of thermochemical processing cells being smaller than the number of sets of thermochemical processing conditions realized. Further, numerous sets of different thermochemical processing conditions are provided in parallel without substantially changing operating

conditions in each of the thermochemical processing cells. Changing the operating conditions within a thermochemical processing cell requires a substantial amount of time and energy. Therefore, having substantially fixed processing conditions or varying the processing conditions in each of the thermochemical processing cells within a portion of the total range of processing conditions for a complete thermochemical process provides considerable time as well as energy savings. Additionally, the invention allows use of thermochemical processing cells, which are operable within a narrow operating range considerably reducing manufacturing costs of each of the thermochemical processing cells, as well as prolonging its lifetime by reducing material fatigue.

None of the prior art cited by the examiner teaches this highly advantageous feature of the multi cell unit as defined by the limitations of amended claim 1, and highlighted in the cited claim above.

Applicant respectfully submits that amended claim 1 is not obvious in light of the teachings of Pelissier in view of Hosokawa, as well as in light of the teachings of Japanese Patent 08178535 in view of Hosokawa and is, therefore, allowable.

Furthermore, the teachings of Pelissier and Japanese Patent 08178535 are related to a completely different field in the art than the teachings of Hosokawa and are facing completely different challenges as outlined above. Therefore, Applicant respectfully submits that there is no motivation to combine the teachings of each of Pelissier and Japanese Patent 08178535 with the teachings of Hosokawa.

The above arguments apply to independent apparatus claims 6, 10, 22, and 32 and independent method claim 26 mutatis mutandis.

Regarding amended claims 3, 13, and 33, dividing a thermochemical process into three portions for processing the workpiece in three thermochemical processing cells further increases the potential for optimizing the operation of a multi-cell thermal processing unit as well as the lifetime of each processing cell by reducing the operational ranges of each processing cell. Hosokawa does not teach anything similar to this method.

Regarding claims 7 and 12, none of the cited references teaches controlling provision of an inert gas in the common chamber.

Referring to amended claim 27, Applicant discloses and claims the method defined by the limitations of claim 26, further comprising the limitation of: "providing a second workpiece to the first thermochemical processing cell after transferring the workpiece to the second thermochemical processing cell". This method is highly advantageous by enabling simultaneous processing of two workpieces, the first one being processed in the second thermochemical processing cell for second thermochemical processing while the second workpiece is processed in the first thermochemical processing cell for first thermochemical processing. None of the cited references teach anything similar to this method.

Referring to amended claim 28, Applicant discloses and claims the method defined by the limitations of claim 26 further comprising the limitations of: "transferring via the common chamber the workpiece from the second thermochemical processing cell to a third thermochemical processing cell linked to the common chamber;" and "thermochemical processing the workpiece by providing third thermochemical processing conditions of the thermochemical process". Dividing a thermochemical process into three portions for processing the workpiece in three thermochemical processing cells further increases the potential for optimizing the operation of a multi-cell thermal processing unit as well as the lifetime of each processing cell by reducing the operational ranges of each processing cell. None of the cited references teach anything similar to this method.

Keeping at least one of the thermochemical processing conditions substantially fixed, as defined by the limitations of claim 29, further increases the lifetime of a processing cell as well as reduces manufacturing costs by simplifying construction and process control of a thermochemical processing cell. None of the cited references teach substantially fixed processing conditions.

Claims 2, 3, 5, 7, 12-14, 16-21, 24, 27-31, 33, and 34 each depend from a claim which is believed to be allowable and are therefore allowable.

Applicant has amended independent claims 1, 6, 10, 22, 26, and 32 in order to more clearly define the subject matter claimed. The subject matter of the amendment is disclosed in paragraph [0002] of the background and in paragraphs [0027] and [0032] of the detailed description. Therefore, no new subject matter has been added.

Dependent claims 3, 13, 16-18, 20, 21, 24, 27 – 31, and 33 have been amended to be consistent with the amended independent claims. No new subject matter has been added.

New claims 35-37 have been added to define the limitation of the thermochemical process being one of nitriding, carburizing, carbo-nitriding, and nitro-carburizing. The subject matter is disclosed in paragraph [0002] of the background and in paragraph [0027] of the detailed description. Therefore, no new subject matter has been added.

Prior Art

The prior art provided but not relied upon by the examiner has been reviewed. However, it is apparent that the reference Maydan et al. (US Patent No. 4,951,601) does not show anything similar to Applicant's invention as defined in the claims above.

Applicant looks forward to favourable reconsideration of the present application.

Please charge $100.00 for one (1) additional independent claim in excess of three to Deposit Account No: 50-1142.

Please charge any additional fees required or credit any overpayment to Deposit Account No: 50-1142.

Respectfully submitted,

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